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TITLE: SWITCHING APPARATUS

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## SWITCHING APPARATUS

### BACKGROUND OF THE INVENTION

**[0001]** The present invention relates to a switching apparatus for selectively engaging and disengaging a mechanism.

**[0002]** Chairs are known to have adjustment mechanisms for their various adjustable parts. For example, an angle a backrest makes with reference to a chair seat may be adjustable by an adjustment mechanism provided between the backrest and the seat. Similarly, the angle that the chair seat makes with reference to a seat support (and thus the floor) may be adjustable by an adjustment mechanism provided between the seat and the seat support. In order to control such adjustment mechanisms, a user operable switching apparatus may be provided.

**[0003]** A switching apparatus may employ a cam rotatable about a pivot by means of a handle. An example of such a switching apparatus is shown in U.S. Patent No. 5,356,200 to Stumpf et al. In certain designs, the cam must bear a significant amount of force and, over time, the cam face may wear down. Excessive wear on the cam face may result in loosening of parts and early breakdown of the switching apparatus. It is thus desirable to design a mechanism with reduced mechanical wear on its key parts. U.S. Patent No. 5,676,425 to Pernicka and U.S. Patent No. 6,394,550 to Liu attempt to address this issue with a bearing plate against which the cam bears. However, the problem of cam wear remains.

### SUMMARY OF THE INVENTION

**[0004]** The present invention provides a switching apparatus having a design intended to reduce wear on its key part. In an embodiment of the invention, a rotatable member is rotatably fixed on a pivot. A slidable bearing member has a first surface for engaging the rotatable member in a non-sliding manner, and an opposite second surface for slidingly

engaging an abutment. Any significant wear on the switching apparatus is more likely to occur between the slidable bearing member and the abutment, rather than between the rotatable member and the slidable bearing member.

**[0005]** In an embodiment, one of the rotatable member and the slidable bearing member includes a protuberance, and the other of the rotatable member and the slidable bearing member includes a corresponding indentation for engagement with the protuberance. The join formed between the protuberance and indentation provides a substantially non-sliding engagement between the rotatable member and the slidable bearing member.

**[0006]** In an embodiment, the rotatable member may comprise a cam having first and second cam faces for defining first and second rotational positions. The slidable bearing member may comprise a slidable bearing plate having first and second edge stops for defining its sliding limits.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0007]** In the figures which illustrate example embodiments of this invention:

**[0008]** **FIG. 1** is a schematic side view of a chair embodying the subject invention.

**[0009]** **FIG. 1a** is a chair adjustment mechanism embodying the subject invention.

**[0010]** **FIG. 1b** is a partially exploded view of the chair adjustment mechanism of **FIG. 1a**.

**[0011]** **FIG. 1c** is a detailed view of an embodiment of a switching apparatus made in accordance with the subject invention.

**[0012]** **FIG. 2a** is a front elevation of the chair adjustment mechanism of **FIG. 1a** in a first position.

**[0013]** **FIG. 2b** is the chair adjustment mechanism of **FIG. 2a** in a second position.

**[0014]** **FIG. 3** illustrates a partial underside elevation of the chair adjustment mechanism of **FIG. 2b**.

**[0015]** **FIG. 4** illustrates an alternative embodiment of a switching apparatus made in accordance with the subject invention.

## DETAILED DESCRIPTION

**[0016]** Referring to **FIG. 1**, a chair **11** comprises a chair seat **13** and a backrest **15** supported on a backrest support bar **17**. The chair seat **13** and backrest support bar **17** are mounted to a chair adjustment mechanism **10** which may be used for adjusting the angle of the backrest **15** (backrest support bar **17**) relative to the seat **13**.

**[0017]** Referring to **FIG. 1a**, chair adjustment mechanism **10** includes a chair seat bracket **20** having mounting flanges **21a** and a mounting rod **21b** for facilitating connection of the seat bracket **20** to other chair adjustment mechanism components (not shown). The seat bracket **20** has first and second support walls **22**, **24** for mounting an adjustment assembly, such as a locking assembly **25**, therebetween. The locking assembly **25** may comprise, for example, a slidable base **26** and a transversely mounted adjustment arm **27** which may be selectively engaged and disengaged from the slidable base **26**. In the present illustrative embodiment, a first tubular spacer **28** maintains a fixed distance between the slidable base **26** of locking assembly **25** and a stirrup-shaped bracket **40**, and a second tubular spacer **29** maintains a minimum distance between the slidable base **26** of locking assembly **25** and the second support wall **24**. The stirrup-shaped bracket **40**, which passes through slots in the first support wall **22**, has a compression function, as described further below.

**[0018]** Referring to **FIG. 1b** (which shows the chair adjustment mechanism **10** of **FIG. 1a** in a partially exploded view to provide the details of the switching apparatus) and **FIG. 1c**, a pin **38** passes in and through bores **40c**, **40d** in the first and second arms **40a**, **40b** of the stirrup-shaped bracket **40**, and in and through a bore **39** in the base **32** of handle **30** in order to pivotally mount the handle **30** between the first and second arms **40a**, **40b** of the stirrup-shaped bracket **40**.

**[0019]** As shown in **FIG. 1c**, handle base **32** has a rotatable member or cam **34** that includes a first cam face **34a** and a second cam face **34b**. In the present illustrative embodiment, there is an indentation or notch **34c** in the nose or apex of the cam **34**, between

the first and second cam faces **34a**, **34b**. The purpose of the notch **34c** is explained further below.

**[0020]** In the present illustrated embodiment, a bearing plate **44** includes a first flanged edge **44a** and a second flanged edge **44b**. As shown, flanged edge **44a** may have a suitably shaped flanged extension **44d** which extends generally towards the second cam face **34b**. A recess **34d** in the second cam face **34b** is sized to receive extension **44d** when the second cam face **34b** engages the bearing plate **44**. As will become apparent from **FIG. 2a** and **FIG. 2b**, below, the flanged extension **44d** may help guard against accidental pinching during operation of the chair adjustment mechanism **10**.

**[0021]** The bearing plate **44** is suitably dimensioned such that the bearing plate **44** is slidable between the first and second arms **40a**, **40b** of the stirrup-shaped bracket **40**, to the extent that the first flanged edge **44a** and the second flanged edge **44b** allow. As shown in **FIG. 1b**, the first and second flanged edges **44a**, **44b** may be dimensioned to act as stops by abutting an edge (the top edge or bottom edge) of the first and second arms **40a**, **40b** of the stirrup-shaped bracket **40**. Bearing plate **44** perpetually engages cam **34** as detailed below.

**[0022]** Now referring to **FIG. 2a** along with **FIG. 1b** and **FIG. 1c**, with bearing plate **44** engaging cam **34**, a nose or protuberance **44c** of the bearing plate engages the notch **34c** in the cam **34**. When handle **30** is in a first position as shown, first cam face **34a** engages a first cam receiving surface **45a** of bearing plate **44**. As shown in **FIG. 2a**, when handle **30** is moved into the first position, the engagement between the nose or protuberance **44c** of the bearing plate **44** and the notch **34c** of the cam **34** slides the bearing plate **44** into its uppermost position between the first and second arms **40a**, **40b** of the stirrup-shaped bracket **40**. Also, as shown, the flanged extension **44d** substantially guards any gap between the bearing plate **44** and the engaging cam **34** to help prevent pinched fingers.

**[0023]** The bearing plate **44** is shown engaging an abutment **46** (**FIG. 2a**) which, in the present illustrative embodiment, comprises the enlarged head of shaft **48**. Shaft **48** bridges the first and second support walls **22**, **24** and may be secured in position by a lock nut **50**. The stirrup-shaped bracket **40** has a central opening (not shown) which receives shaft **48** with a suitable clearance allowing free movement. Encircling the shaft **48** and located

adjacent to the first support wall 22 is a first coil spring 52. As shown in FIG. 2a, coil spring 52 is in compression and biases a base 40e of the stirrup-shaped bracket 40 away from the first support wall 22 and against tube 28. This urges tube 28, and slidable base 26 toward support wall 24.

**[0024]** As the first and second arms 40a, 40b of the stirrup-shaped bracket 40 are pinned by pin 38 to base 32 of handle 30, the first coil spring 52 thus also acts to urge cam 34 against the bearing plate 44, and the bearing plate 44 against the abutment 46. Thus, the stirrup-shaped bracket 40 has a compression function, and is hereafter referred to as compression member 40. A second coil spring 54 encircling shaft 48 acts opposite to the first coil spring 52 and biases the slidable base 26 of locking assembly 25 away from the second support wall 24. The first coil spring 52 is stronger than the second coil spring 54, and thus provides sufficient force opposing coil spring 54 to keep the base of compression member 40 biased away from first support wall 22. The maximum stand-off of the base 40e from the support wall 22 is defined by the cam 34 and bearing plate 44 which are jammed against the head of shaft 48, which in turn is jammed against the support wall 22.

**[0025]** Now referring to FIG. 2b along with FIG. 1b and FIG. 1c, the chair adjustment mechanism 10 of FIG. 2a is shown with handle 30 lifted to a second position. As shown, the movement of handle 30 by a user causes second cam face 34b to engage a second cam receiving surface 45b of bearing plate 44. As shown, the flanged extension 44d is received within the corresponding recess 34d in the second cam face 34b.

**[0026]** In the present illustrative embodiment, the notch 34c receives a cooperating protuberance 44c in bearing plate 44 and this join is maintained as handle 30 is moved from one position to another. Thus, this join slides bearing plate 44 down as the handle 30, and cam 34, are rotated to the second position shows in FIG. 2b.

**[0027]** Still referring to FIG. 2b, the movement of handle 30 into the second position causes the distance between the cam pivot (i.e. pin 38) and bearing plate 44 to be defined by the second cam face 34b. In the present illustrative embodiment, second cam face 34b causes the pivot pin 38 to move further away from bearing plate 44 than when first cam face 34a engages bearing plate 44. Thus, compression member 40 is pulled outwardly, in the

general direction of arrow 65. The length of the stroke of compression member 40 is determined by the difference in distances from first cam face 34a to pivot pin 38, and second cam face 34b to pivot pin 38. In the present illustrative example, the length of the stroke of compression member 40 is indicated at S. This movement of compression member 40 also has the effect of compressing first coil spring 52 by the same distance S. Also, by action of coil spring 54 which extends by the same distance S, the slidable base 26 of locking assembly 25 slides towards first support wall 22 by the same distance S. However, the transversely mounted adjustment arm 27 does not move in relation to first support wall 22 (assuming that the adjustment arm 27 is non-slideably connected at its other end to another chair adjustment mechanism component). This relative movement between the slidable base 26 and transversely mounted adjustment arm 27 of locking assembly 25 may have the effect, for example, of engaging or disengaging a clutch mechanism (not shown) formed between the slidable base 26 and adjustment arm 27. Thus, for example, FIG. 2a may illustrate a locked position wherein the transversely mounted adjustment arm 27 is locked relative to the slidable base 26, and FIG. 2b may illustrate a corresponding unlocked position.

[0028] Referring to FIG. 3, the chair adjustment mechanism 10 of FIG. 2b is now shown in an underside elevation view with bi-directional arrow 68 showing a possible movement of adjustment arm 27 relative to slidable base 26 when the slidable base 26 is in an unlocked position. For clarity, only a portion of the adjustment arm 27 is shown in FIG. 3. In operation, the adjustment arm 27 may be coupled to another chair bracket component by, for example, mounting bolt 70 and matching nut 72.

[0029] Bearing plate 44 provided between the cam 34 and the abutment 46 avoids sliding engagement between cam faces 34a, 34b and abutment 46. Instead, cam faces 34a, 34b engage the bearing plate 44 in a rocking manner about notch 34c so that it is the opposite surface of the bearing plate 44 that bears the brunt of the wear as it slidingly engages the abutment 46. In this regard, the second face of bearing plate 44 should be made sufficiently smooth so as to facilitate smooth sliding of bearing plate 44 against abutment 46, and be made sufficiently hard to resist wear. Even as the bearing plate 44 wears down, it does not reduce the ability of the mechanism to switch between positions. In other words, since it is the cam 34 that provides the key positional information for handle 30 and the

adjustment mechanism 25, it will be appreciated that wear of the bearing plate 44 is less critical than wear of the cam 34. Further, even should the bearing plate wear out, it would be less expensive to replace than the handle 30 and cam 34.

**[0030]** In the present illustrative embodiment, the base 32 of handle 30 has flanged extensions 32a, 32b which reduce the risk of pinched fingers.

**[0031]** An advantage of transversely mounting the adjustment arm 27 to the slidable base 26 of the locking assembly 25 is that the force necessary to arrest the motion in the directions indicated by bi-directional arrow 68 is not translated to the switching apparatus (since a force in the direction of bi-directional arrow 68 is substantially perpendicular to shaft 48). Rather, the forces that bear on cam 34 and bearing plate 44 are largely provided by first coil spring 52 and second coil spring 54. The light switching action made possible by limiting the magnitude of forces to that necessary to slide the slidable base 26 of locking assembly 25 in and out of locking position relative to the adjustment arm 27 also reduces wear on the first and second cam faces 34a, 34b and notch 34c, and on the bearing plate 44.

**[0032]** While the present illustrative embodiment shows a notch 34c provided in cam 34 which cooperates with protuberance 44c provided on bearing plate 44, this specific joining arrangement is not necessary. For example, rather than having a substantially flat cam receiving surface on the bearing plate 44, the surface of bearing plate 44 could be slightly angled to form a shallow V-shaped valley having first and second cam receiving surfaces, as seen in FIG. 4 at 45a', 45b'. First and second cam faces 34a', 34b' could then define a cooperating angled cam face, without notch 34c, which rocks between the walls of the V-shaped valley formed by the first and second cam receiving surfaces 45a', 45b'. In this case, the entirety of the V-shaped valley in bearing plate 44 can be characterized as an indentation, and the apex between the first and second cam faces 34a', 34b' can be characterized as forming a protuberance. It will be apparent to those skilled in that art that various other embodiments are possible to substantially prevent sliding between the cam 34 and the bearing plate 44 while the opposite side of bearing plate 44 slidably engages abutment 46.



**[0033]** Also, while the present illustrative embodiment describes a rotatable member or cam having two faces, it will be apparent to those skilled in the art that more than two faces may be provided (e.g. three faces), such that there are a corresponding number of rotational positions of the rotatable member which define a corresponding number of different distances from the pivot. This may be useful if more than two positions are required for controlling an associated adjustment or locking mechanism.

**[0034]** Furthermore, in an alternative illustrative embodiment, spacers **28**, **29** may be integrated with the design of the compression member **40** and/or the slidable base **26** of locking assembly **25**. If the compression member **40**, spacer **28**, and slidable base **26** are functioning as an integrated unit, the second coil spring **54** may be omitted.

**[0035]** Although springs are used throughout the above disclosure, other resilient members may be used in place of springs, such as resilient clips.

**[0036]** While the switching apparatus has been described as operating a clutch arrangement, (comprising the slidable base **26** and adjustment arm **27**) it will be appreciated that the switching apparatus may be employed to operate any variety of mechanisms.

**[0037]** The cam faces **34a**, **34b**, when flush against the bearing plate **44**, naturally act as a stop. In consequence, it will be apparent that the flanges **44a**, **44b** of the bearing plate **44**, which act as auxiliary stops, may, in some situations, not be needed.

**[0038]** The switching apparatus could function even if the cam **34** did not have faces which abutted the bearing plate **44** to define limit stops for cam rotation, provided the switching apparatus had some other cam stop, such as cam flanged extensions **32a**, **32b** hitting a respective flanged end **44a**, **44b** of the bearing plate **44**.

**[0039]** Other modifications will be apparent to those skilled in the art and, therefore, the invention is defined in the claims.